Effect of physical training performed on unstable surfaces with use of elastic bands for resistance exercises on physical performance and quality of life in elderly persons

Wpływ treningu fizycznego wykonywanego na powierzchniach niestabilnych z wykorzystaniem elastycznych taśm do ćwiczeń oporowych na sprawność funkcjonalną oraz jakość życia osób starszych

Sylwia Mętel [A,B,D,E,F,G], **Bożena Jasiak–Tyrkalska** [C,D,E]

Institut of Physiotherapy WOZ CM Jagiellonian University, Kraków, Poland

Authors' contribution: A – project of the study, work; B – collection of the data, information; C – statistical analysis; D – data interpretation; E – preparation of the manuscript; F – literature query; G – obtaining funds

Received: 09.10.2006; accepted 17.11.2006

Key words

sensorimotor exercises, resistance exercises, physical performance, quality of life

Abstract

Aim of the study. The authors tried to evaluate the effectiveness of physical exercises, particularly exercises on unstable surfaces, in improving functional efficiency and self-evaluation of quality of life in elderly people.

Material and methods. The experiment was completed by a group of 37 out of 45 participants who had fulfilled selection criteria. Age range was from 65 to 90 years, and the average age was 79.5 + 12 years. The following tests were administered: manipulation test, Get Up And Go Test, Tinetti Balance and Walking Test, Single Leg Stance with Eyes Open and Closed, The Sit-And-Reach Test and measurement of back muscles strength. For subjective quality of life evaluation, psychometric testing was employed: SF-36 Health Questionnaire Survey and Life Satisfaction Index. The participants performed physical exercises 3 times a week for 3 months, attending 33 sessions of 45 minutes duration each. The exercises defined in the training schedule were performed individually and under supervision of the physiotherapist. Use of special tools (the Swiss ball, the sensory pillow, and the elastic band) enabled performance of sensorimotor and resistance exercises whilst encouraging a sense of play, which facilitates achieving the aims of therapy.

Results. Statistically significant improvement following the physical training was noticed only in the strength of back muscles ($p<0.001$), in the manipulation ability test ($p<0.01$), and in the Single Leg Stance with Eyes Open test ($p<0.05$). In physical categories of quality of life in the SF-36 test, statistically significant improvement was confined to the categories: "role limitations due to physical problems" ($p<0.05$) and "general health self-perception" ($p<0.001$). Among all mental categories of the SF-36 test, statistically significant difference was found only in "role limitations due to emotional problems" ($p<0.01$) and in "vitality" ($p<0.05$).

Conclusions. The applied physical exercise programme positively influences the results of two out of seven tests describing physical performance of elderly people. Higher self-evaluation of quality of life was reported by these people in two physical categories and in two mental categories of the SF-36 test.

Słowa kluczowe

ćwiczenia sensomotoryczne, ćwiczenia oporowe, sprawność funkcjonalna, jakość życia

Streszczenie

Cel pracy. Autorzy przedstawili próbę oceny skuteczności treningu fizycznego, uwzględniającego szczególnie ćwiczenia na powierzchniach niestabilnych, na sprawność funkcjonalną oraz samoocenę jakości życia osób starszych.

Materiał i metody. Eksperyment ukończyła grupa 37 osób z pośród 45, które spełniały kryteria kwalifikacyjne. Wiek badanych wahał się w granicach od 65 do 90 lat. Średnia wieku wynosiła 79,5 ± 12 lat. Kryterium oceny sprawności funkcjonalnej stanowiły testy: sprawności manipulacyjnej, wstań i idź, równowagi wg Tinetti, chodu wg Tinetti, stania na jednej nodze z oczami otwartymi i zamkniętymi, wysięgu w siadzie oraz badanie momentu siły mięśni grzbietu. Dla subiektywnej oceny jakości życia wykorzystano testy psychometryczne: SF – 36 oraz Indeks Satysfakcji z Życia. Osoby biorące udział w eksperymencie, wykonywały ćwiczenia fizyczne 3 razy w tygodniu przez okres 3-ch miesięcy, uczestnicząc w 33 sesjach, trwających po 45 minut. Ćwiczenia określone harmonogramem treningowym były prowadzone indywidualnie pod nadzorem fizjoterapeuty. Zastosowanie do ćwiczeń przyborów (piłka szwajcarska, poduszka rehabilitacyjna i elastyczna taśma) umożliwiało wykonywanie ćwiczeń sensomotorycznych oraz oporowych, zapewniając jednocześnie efekt zabawy, ułatwiający osiąganie zamierzonych celów terapii.

Wyniki. We testach charakteryzujących sprawność funkcjonalną istotną statystycznie poprawę średnich wyników na poziomie $p < 0,001$ zaobserwowano w pomiarze momentów siły mięśni grzbietu, na poziomie $p < 0,01$ w ocenie sprawności manipulacyjnej oraz na poziomie $p < 0,05$ w próbie stania na jednej nodze z otwartymi oczami. W ocenie komponenty fizycznej jakości życia testem SF – 36, istotną statystycznie poprawę średnich wyników stwierdzono tylko w przypadku kategorii „ograniczenia wynikające ze stanu zdrowia" ($p < 0,05$) oraz „percepcji własnego stanu zdrowia" ($p < 0,001$). W ocenie komponenty mentalnej istotną statystycznie poprawę średnich wyników zaobserwowano w przypadku kategorii „ograniczenia wynikające z problemów emocjonalnych" ($p < 0,01$) oraz „witalność" ($p < 0,05$).

Wnioski. Znamiennie skuteczny wpływ zastosowanego treningu fizycznego odnosi się tylko do dwóch z siedmiu badanych cech sprawności funkcjonalnej osób starszych. Wyższą samoocenę jakości życia po programie treningowym zaobserwowano w przypadku dwóch kategorii komponenty fizycznej oraz dwóch kategorii komponenty mentalnej testu SF- 36.

Introduction

The phenomenon of demographic aging of human population in the world was noticed as early as over 30 years ago. In 1973, United Nations General Assembly accepted a resolution pertaining to older persons. The resolution stated that aging of people in the world is a universal, although variable in time and space, process, significant for all domains of life, permanent and irreversible[1]. Most recent United Nations studies confirm the fact of increasing mean human life span and ageing of world societies. Currently, mean human life span worldwide is 66 years and is markedly different in various geographic regions[2].

In Poland, persons older than 65 years also constitute the most rapidly enlarging age group. According to GUS (Central Statistical Office) studies, the number of seniors is currently near 6 millions and it is estimated that in 2020, this number will increase to 8.5 millions, which will constitute 23% of Polish population, with a markedly higher prevalence of persons at late senility[3].

Loss of physical agility in the elderly constitutes a problem not only for the patient himself, but also a social problem because of the increased costs associated with therapy and care for these persons. A significant number of elderly persons naturally adjust to the sitting style of life, which finally becomes a threat for their independence and self-sufficiency and constitutes a risk factor for occurrence of chronic diseases thus resulting in long-term hospitalisations.

Physical activity is especially important in striving after slowing down the unfavourable biological and non-biological changes, alleviation of troublesome and unpleasant symptoms accompanying aging. Thanks to physical exercises, it can usually be managed to delay the development of disability, which – according to Fries'

hypothesis – results in a markedly lower ultimate level of disability. Initiation and continuation of exercises of a small or moderate intensity may contribute to limiting the sequels of chronic diseases of old age[4,5].

Effects of physical exercises in the elderly are unequivocally beneficial. Their positive effects do not decrease with age and are independent of gender or race[4,6,7,8]. Research studies demonstrate that increased motor activity has a widespread impact on the whole organism, particularly on the motor, cardiovascular, respiratory, and nervous systems. For persons at older age, it is recommended to participate in an appropriate physical training. According to Kuński, this is a consciously-regulated process involving purposeful use of precisely determined physical exercises performed in order to achieve physical and mental effects counteracting age-associated organism's adaptation abilities for physical effort. Physiological effects achieved as a result of such training may constitute important factors contributing to health reinforcement and prevention or reduction of development of many diseases, for which reduced physical activity is an important risk factor[9].

Currently, there are ongoing studies on elaboration of physical activity programmes adjusted to the needs of elderly persons that would allow them to maintain physical fitness and thus better quality of life for a possibly long period of time. So far, there has been no agreement as to the form of an optimal exercise programme that would be most beneficial for health and that would most significantly improve functioning of the elderly in daily life. It seems that physical training programme comprising precisely defined exercises as to their type, intensity and frequency and adjusted to physical endurance of the organism may constitute an effective form of premature aging prevention as well as may augment capability of adaptation to age-related involution changes.

Aim of the study

The aim of this study was to assess whether a 3-month home-based physical training can improve physical performance, increase satisfaction of life and thus improve quality of life in elderly persons.

Material

The programme comprised persons living in Kraków, who had obtained information about the possibility to participate in such programme from selected Nursing Homes, family physicians, and from a TV programme. Positive opinion of Ethical Committee at Regional Medical Chamber in Kraków enabled conduction of the planned medical experiment.

Study inclusion criteria included:

- patient's consent to participate in the programme,
- written permission from a family physician or a specialist allowing the persons to participate in the experiment,
- age range: 65-90 years,
- physical agility status allowing achievement of a score of at least 21 points in the Berg test of agility[10,11],
- mental status allowing conduction of psychometric tests (at least 24 points in the MMSE)[12,13].

Persons who had kinesitherapy within 6 months preceding study onset were excluded from the study.

Forty five of 60 persons who expressed their will to participate in the experiment were enrolled into the study, while 37 persons completed the whole programme (27 women and 10 men). Participants' age ranged 65 to 90 years, mean age was 79.5±12 years. The studied group included 13 persons living alone, 15 persons living with family, and 17 residents of nursing homes.

Two persons withdrew from the study because of worsening of their health status (temporary aggravation of ailments associated with Parkinson's disease). Two further persons died during the programme. A physician withdrew another 1 person from the study. Three persons resigned because of personal reasons.

Method

Prior to commencing the training programme and after its termination, the following functional tests were performed: Single Leg Stance[14,15,16], Get Up And Go test[17,15], The Sit-And-Reach Test[14,16,18] , Tinetti Balance and Gait Evaluation[19,16,11], assessment of manipulation agility – The Nine Hole Peg Test[20,21], and dynamometric measurement of muscle torque of back extensors[22].

Assessment of muscle torque of the back was conducted on a unit for muscle strength measurements during conditions of isometric contraction in the Department of Biomechanics at Academy of Physical Education in Kraków. The measurement line consisted of the following items: tensometric transducer manufactured by the company Hottinger, tensometric bridge, and a computer as the recording unit.

Quality of life was evaluated using the SF-36 Health Questionnaire Survey[23,24,25,26,27] and the Life Satisfaction Index[28,29].

A computer programme Statistica 6.0[30] was used for statistical analysis. As the distribution of the evaluated features was Gaussian, the parametric Student's t-test was applied. The level of statistical significance was set at $p < 0.05$. In the graphic presentation of differences in the evaluated variables, mean value ($\bar{x}$) and standard error of the mean (SEM) were used.

Training programme

Participants of the experiment performed physical exercises 3 times a week for a period of 3 months, participating in a total of 33 sessions, each lasting 45 minutes.

Prior to each exercise session, heart rate and blood pressure were measured and during each session, intensity of the exercises was assessed using the Talk-Test. The test is a simple method monitoring intensity of a conducted physical training. If a person performing physical exercises is able to simultaneously sing, the training intensity is small. Physical activity allowing unrestrained talking is characteristic for a training of medium intensity. Physical training conducted intensively does not enable simultaneous unrestrained talking[31,32].

Exercises defined in the training schedule as medium intensity exercises were conducted individually under supervision of a physiotherapist.

Use of very functional and relatively inexpensive instruments during the exercises (Swiss ball, rehabilitation pillow, elastic band) allowed performance of sensorimotor exercises and exercises increasing muscle strength.

To activate postural muscles, the exercises were performed on the rehabilitation pillow. Performance of exercises on an unstable surface particularly activates deep muscle stabilisers because of the fact that it is not possible to precisely plan a movement that would guarantee maintenance of stable body position.

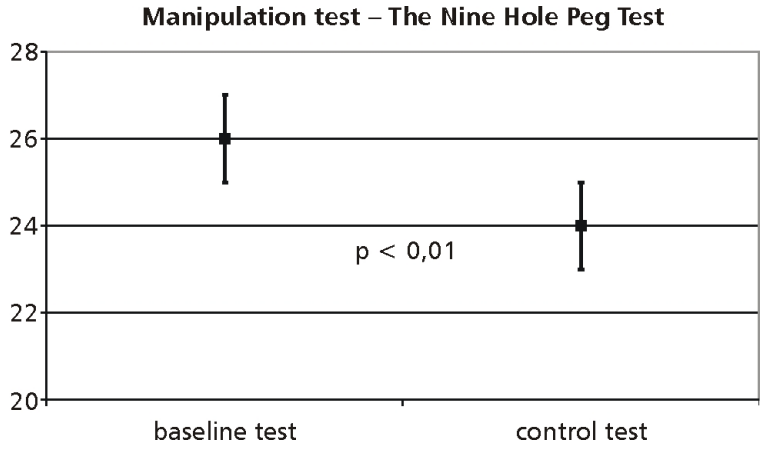
Age-related reduction in skeletal muscle strength pertains especially to the muscles of the back. To enable elderly persons to perform exercises reinforcing back muscles in a supine position on the abdomen, Swiss ball was used as the ground. Red elastic band ("medium resistance") was used for resistance exercises.

It was aimed to conform to the rule of exercise progression by gradually increasing the number of repetitions of a given exercise or difficulties were introduced involving a reduction of external stabilisation of the exercising person (e.g. securing the patient by holding him with one arm instead of two arms) or of internal stabilisation (e.g. performance of exercises with eyes closed).

Study results

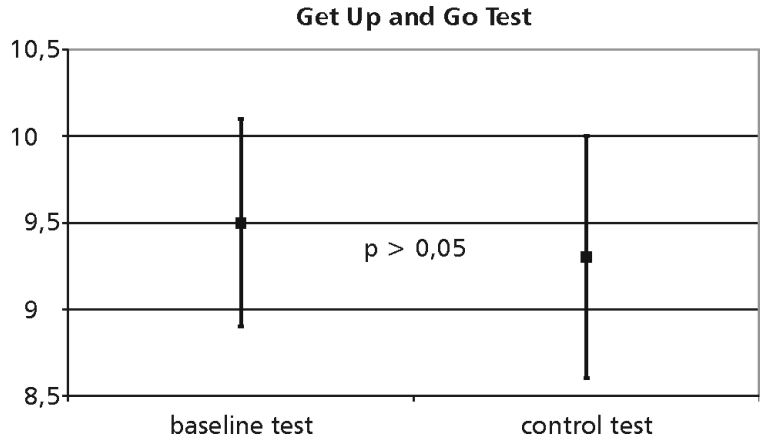
In the tests characterising physical performance, there was an improvement in mean values of test results. A significant improvement was observed in the strength of muscles of the back ($p<0.001$) (Figure 7), in manual agility ($p<0.01$) (Figure 1), and in the trial of single leg stance with eyes open ($p<0.05$) (Figure 5). In the remaining tests, no significant improvement was achieved (Figures 2, 3, 4, 5, 6).

Improvements in mean values were observed in all categories of quality of life in the physical component of the SF-36 test. Significant improvement was observed only in the domains "role limitations due to physical health problems" ($p<0.05$) and "general health perceptions" ($p<0.001$) (Figure 8).



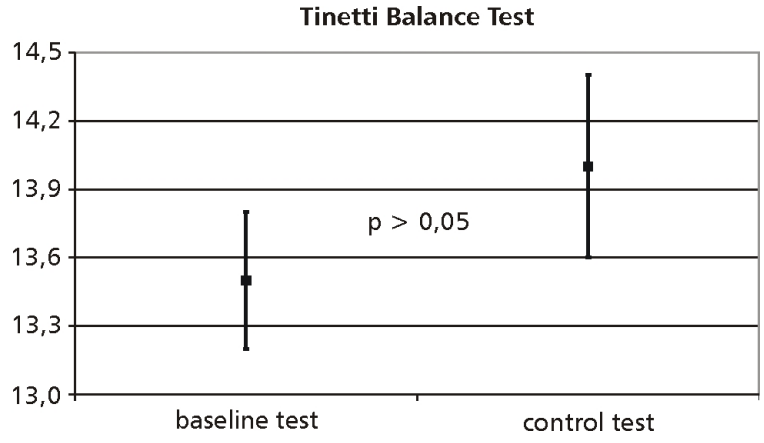
Picture 1

Comparison of mean performance times ($\tilde{x}$ ± SEM) in the manipulation test – The Nine Hole Peg Test



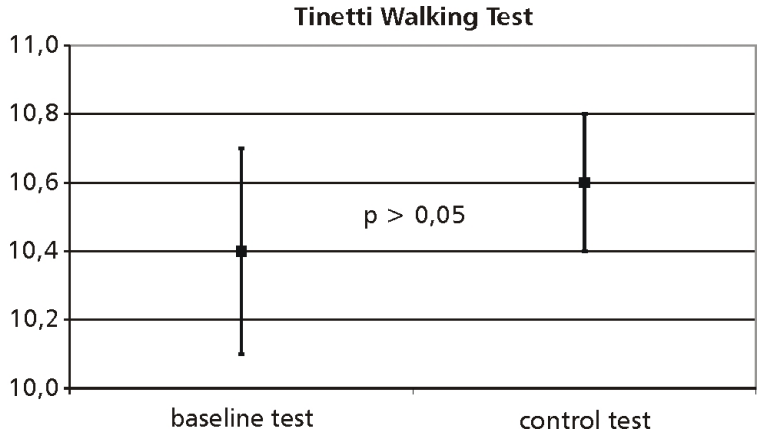
Picture 2

Comparison of mean performance times ($\tilde{x}$ ± SEM) in the Get Up And Go test



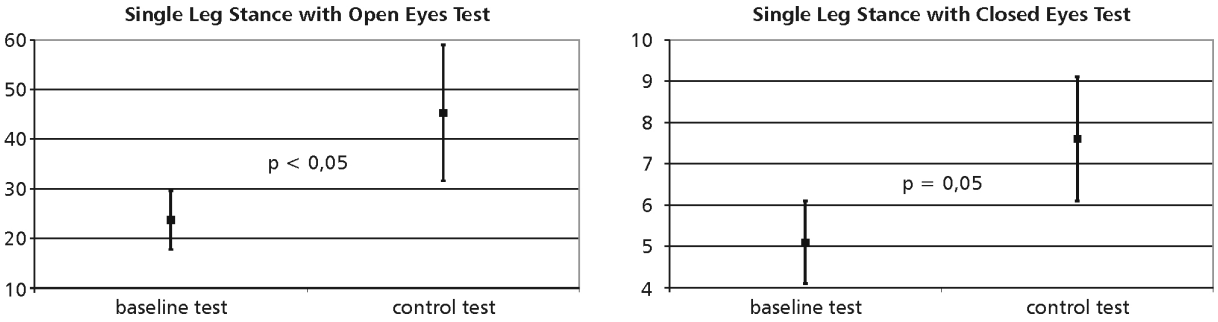
Picture 3

Comparison of mean scores ($\bar{x}$ ± SEM) obtained during performance of the Tinetti Balance test



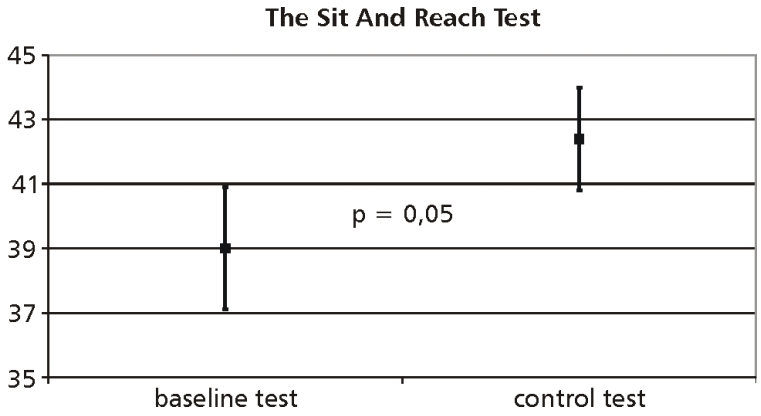
Picture 4

Comparison of mean scores ($\bar{x}$ ± SEM) obtained during performance of the Tinetti Walking test



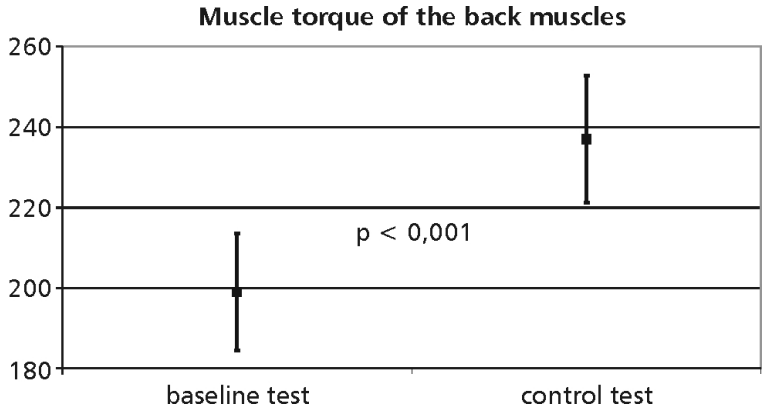
Picture 5

Comparison of mean performance times ($\bar{x}$ ± SEM) in the Single Leg Stance with Eyes Open and Closed test



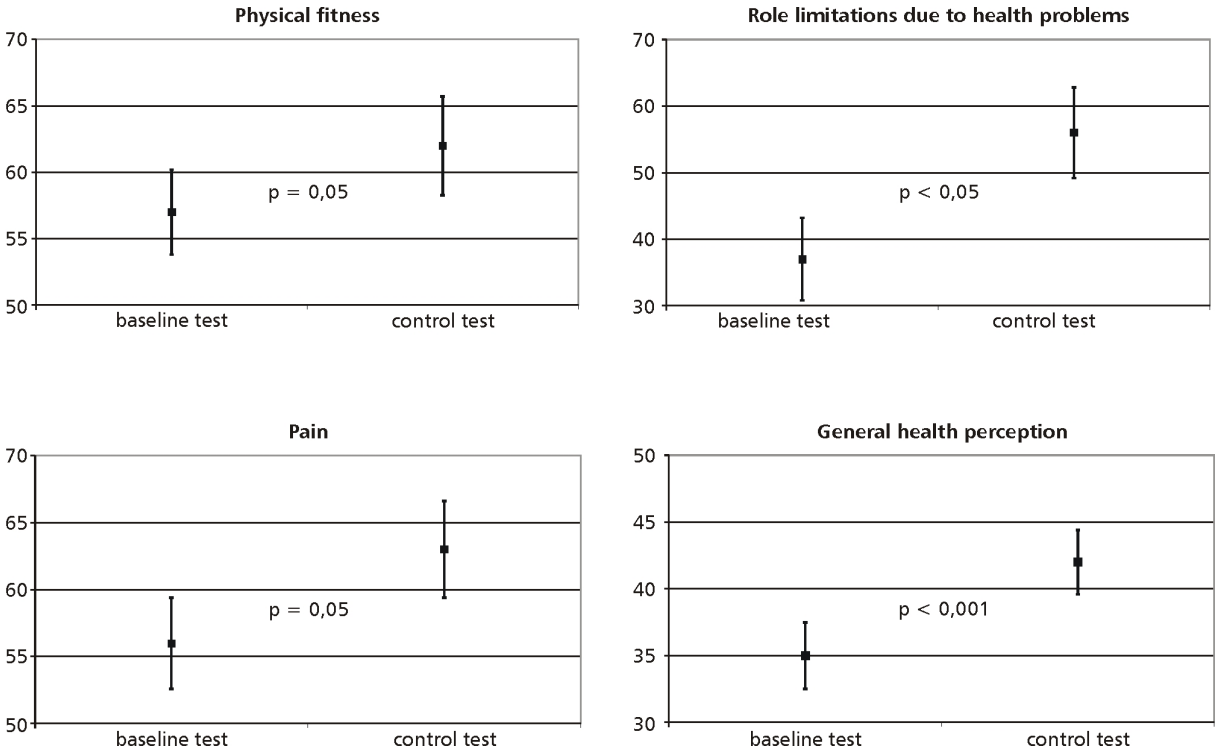
Picture 6

Comparison of mean reach lengths ($\bar{x}$ ± SEM) obtained during The Sit And Reach test



Picture 7

Comparison of mean muscle torque of the back muscles ($\tilde{x}$ ± SEM)

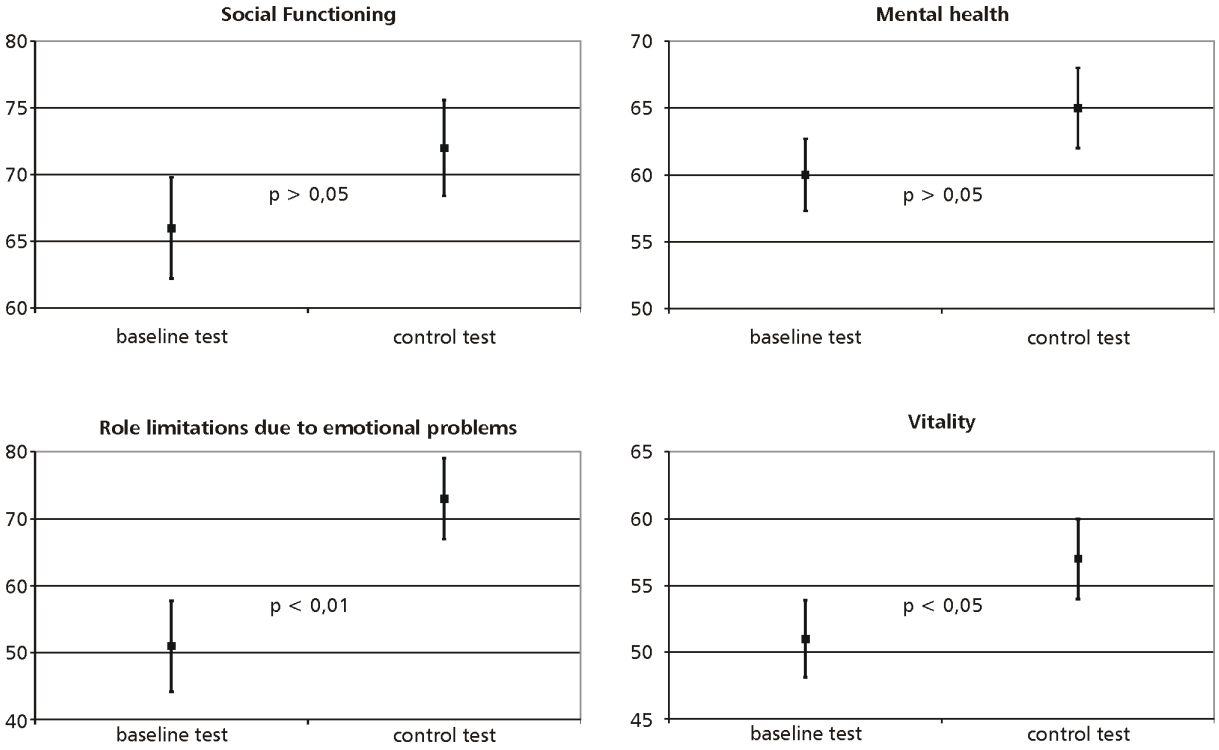


Picture 8

Comparison of mean scores ($\tilde{x}$ ± SEM) of categories of Quality of Life evaluated for the physical component of the SF-36 test

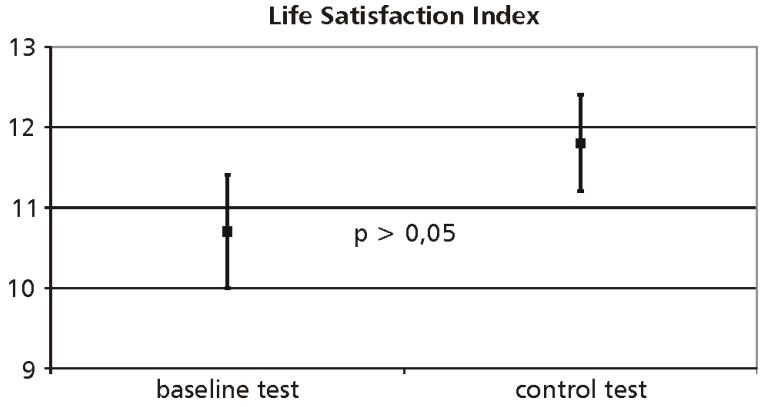
Also in the mental category was an improvement in test results in all domains achieved. The improvement was significant in the domains "role limitations due to emotional problems" ($p<0.01$) and "vitality" ($p<0.05$) (Figure 9).

In the index of satisfaction of life, there was an insignificant improvement (Figure 10).



Picture 9

Comparison of mean scores ($\bar{x}$ ± SEM) of categories of Quality of Life evaluated for the mental component of the SF-36 test



Rycina 10

Comparison of mean scores ($\bar{x}$ ± SEM) of the Life Satisfaction Index

Discussion

Considering marked prolongation of human life span and constantly increasing number of elderly persons, running a sitting style of life, it has become more and more necessary to elaborate and introduce efficacious physical activity programmes that would contribute to attenuation of unfavourable changes associated with aging and

poverty of physical activity thus improving quality of life of the elderly. It was, namely, noticed that physiological aging of a human being is accompanied by involution of tissues and organs, impairment of regulatory mechanisms, as well as by decreasing adaptation capabilities of the organism[33,34,35].

Bortz suggested that some of the changes in human organism ascribed solely to the process of aging result in fact from a deficiency or lack of physical activity and that performing physical exercises can contribute to reducing these changes[36].

The search for therapeutic methods that could be introduced in the environment of an elderly person has become the aim of not only researchers but also social institutions. Designing both optimal and simple algorithms of rehabilitational management directed at improving independence, safety of locomotion, and widely comprehended quality of life has become a challenge for contemporary medicine. The experiment described above aimed exactly at determining the effects of a health-promoting training on quality of life in geriatric patients.

Ability to maintain balance worsens with age, which in turn increases the risk of falls and frequently leads to fractures and multiple medical complications possibly affecting the whole organism. Physical activity becomes reduced, which results in decreased independence, necessity to rely on other persons, and, consequently, in reduced quality of life[35,37,38,39,40,41,42].

The mechanism of maintaining balance involves many factors. Primarily, it is dependent on proper functioning of the sensory and motor systems and their cooperation, as well as on ongoing diseases and methods of their treatment[39,43].

Vision, vestibular system, proprioception and skin receptors constitute the components of balance responsible for perception of sensory information.

In elderly persons, worsening quality of vision resulting from narrowing of the visual field, attenuation of contrast perception and visual depth induce an impairment of the quantity and quality of information perceived by the sense of sight[38].

Involution changes accompanying aging also compromise functioning of the vestibular system[43,44]. In persons older than 70 years, there is atrophy of approximately 40 percent of sensory cells of the vestibular system[38,45]. Perception of sensory information stemming from proprioceptors and skin receptors also becomes attenuated[38,43].

Disturbances in functioning of one of the components of the sensory system may to some degree be compensated by augmented perception from another component. However, in the elderly, compensation of reactions associated with maintenance of balance is limited and requires reorganisation in the system of sensorimotor control[46]. It was found that the status of this reorganisation correlates with the number and type of "sways" recorded during performance of balance tests. It was also observed that balance tests performed simultaneously with memory tasks and with reduced sensory information result in a markedly increased necessity to concentrate in these persons as compared to young individuals[46,47].

Results of the studies conducted in the last decade indicate that elderly persons compensate for the involution changes in the perception and processing of sensory information by using a strategy of tensing (stiffening) the muscles of lower limbs during the tests assessing static balance performed with eyes open or closed. Therefore, in persons older than 65 years, the importance of visual control in maintaining static balance is lower than in younger persons, while activity of peripheral receptors is the most important element of the sensory system controlling postural stability[37,38,48].

As maintenance of balance is one of the most important indices of functional agility in elderly persons, we decided to conduct 4 different tests evaluating balance status in our study (Figures 2-5).

Statistically significant improvement was observed only in the Single Leg Stance test with Eyes Open ($p<0.05$). In the remaining balance tests, the improvement in mean test results was not statistically significant. It is possible that this finding confirms the above-mentioned strategy of tensing (stiffening) of muscles of the lower extremities.

Compensation of the sensory function is possible in trained elderly persons, who perform exercises designed to increase proprioceptive stimulation on a regular basis[43].

This is confirmed by results obtained by Gauchardi et al.[43] in persons older than 60 years. In this study, effects of exercises aiming at amelioration of functioning of the proprioceptive system (yoga, mild exercises) were compared to a programme of dynamic aerobic exercises (jogging, swimming, bicycle riding). It was found that systematic performance of dynamic exercises by elderly persons induces a marked increase in skeletal muscles strength and power but only a small improvement in balance, whereas the programme of sensorimotor exercises markedly improves both static and dynamic balance and increases muscle strength similarly to the mentioned programme of aerobic exercises. In the described study, it was demonstrated that the effectiveness of

physical training in maintaining and improving balance in the elderly does not require high intensity exercises but should particularly be aimed at ameliorating proprioception.

Balance impairment accompanying the process of aging is also a result of changes in the motor system. There is atrophy of muscle fibres, increased amount of adipose tissue and non-contractile connective tissue in the muscular system, which reduces the effectiveness of this system and decreases muscle strength and mass[13,49,50,51,52]. Muscle strength reduction seems to merely result from atrophy of muscle fibres rather than from disturbances of motor processing in the central nervous system[53].

In our study, we observed a statistically significant ($p<0.001$) increase in the strength of muscles of the back (Figure 7). It is likely that such effect was achieved by using unstable surfaces for the exercises. Performing physical exercises on an unstable surface induces increased activation of deep muscles of the back originating directly on vertebral bodies. Additionally, in order to provide a progressive level of difficulty in exercise performance and to more powerfully affect muscle strength, resistance exercises with use of elastic bands were introduced. Application of these instruments might have also contributed to the improvement in the strength of the described muscle group.

Many authors emphasize that elastic bands-assisted resistance training may increase muscle strength in elderly persons.

Zion et al.[54] conducted a study on the effect of an 8-week home-based resistance training programme with use of elastic bands in 8 elderly persons with orthostatic hypotension. They demonstrated a significant improvement in dynamic assessment of muscle strength and physical performance and reported no falls during the study period.

Also Baum et al.[55] confirmed usefulness of resistance exercises performed with elastic bands by evaluating their effects on physical agility of physically weak persons aged from 75 to 99 years.

Therefore, it can be concluded that supervised physical exercises may be an efficacious strategy towards maintenance as well as improvement of functional agility of the elderly, which is reflected in a better quality of life.

In our experiment, we decided to use Swiss ball and rehabilitation pillow for this type of exercises. Introduction of these instruments into the training programme helped in performing appropriate balance and reinforcement exercises.

In case of patients at geriatric age, Swiss ball allows conduction of balance exercises in a sitting as well as a supine position provided appropriate support is given by a physiotherapist. Even just sitting on the Swiss ball induces sensorimotor activation. Furthermore, rehabilitation pillow enables elderly persons to perform balance exercises in a standing position. Moreover, it seems that application of instruments during exercises augments their attractiveness thus maintaining motivation to complete the whole training programme. It also turned out that exercises with Swiss ball, rehabilitation pillow, and band can be not only effective but also very practical in terms of possibility to perform them on a small area and in different living environments of the elderly.

Of the remaining results of tests evaluating the effect of training on functioning of the participants, the test of manual agility is remarkable. Mean performance time of the test was reduced and the changes in the assessed parameters were statistically significant at a level of $p<0.01$ (Figure 1).

In the assessment of quality of life, we noticed that there was an improvement in all categories of the physical domain (Figure 8) of the SF-36 test; however, significant improvement was observed only in categories "role limitations due to physical problems" ($p<0.05$) and "general health self-perception" ($p<0.001$). Similarly to the physical domain, improvements in mean results in all categories were observed also in the mental domain (Figure 9). Significant improvement was found only in the categories "role limitations due to emotional problems" ($p<0.01$) and "vitality" ($p<0.05$).

In Life Satisfaction Index (Figure 10), as the second quality of life self-evaluation test, insignificant improvement was observed in the mean result.

Similar conclusion was drawn by Berret et al.[56]. They compared the effect of training with progressive resistance to suppleness training in 40 elderly persons and did not find statistically significant changes in quality of life for any of the training modes.

Results of the conducted experiment – introduction of three-month health training seem interesting, because:

- this was one of the first research studies, where it was shown that elderly persons (including persons in their nineties) – under appropriate support of a physiotherapist – are able to perform physical exercises on an unstable surface inducing increased load for the sensorimotor system;

- the elaborated physical exercises programme with use of Swiss ball, rehabilitation pillow, and elastic band has a significant practical application, as it can be used for exercises with elderly persons in ambulatory conditions and at home;
- sensorimotor exercises may improve physical performance in older persons, which is associated with maintaining independence by these persons and limiting care and financial resources related to rehabilitation of this group of people
- a change to a more active lifestyle by participation in the designed physical training programme may be beneficial for the physical and mental domain, which is reflected in improved quality of life of elderly persons.

Conclusions

1. Significantly positive effect of the applied physical training is evident only in such features of functional agility of elderly persons as: strength of back muscles, manipulation agility, and single leg stance with eyes open.
2. "Role limitations due to physical problems" and "general health self-perception" of the physical domain and "role limitations due to emotional problems" and "vitality" of the mental domain are the categories of self-assessment of quality of life that were significantly improved as a result of the applied physical training. .

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Address for correspondence

Sylwia Mętel

Zakład Fizjoterapii WOZ Collegium Medicum UJ / Institut of Physiotherapy WOZ CM Jagiellonian University

Plac Sikorskiego 2/7

31-115 Kraków, Poland

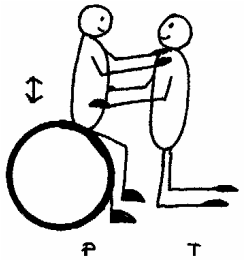
phone: +48 (0)12-422-56-83

e-mail: smetel@cm-uj.krakow.pl

Translated from Polish into English language: Marcin Tutaj, MD, PhD

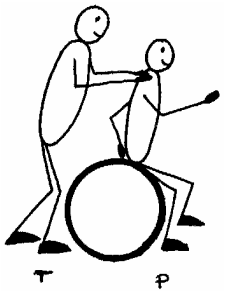
Set of exercises with the Swiss ball and elastic band

In patients with advanced degenerative changes, the exercises with balancing on the ball were not performed.



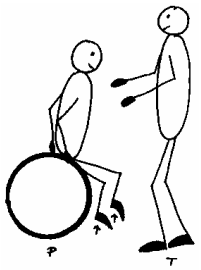
Ex. 1

Start position (SP) – sit on the ball, Legs (LL) spread apart. Balancing on the ball.



Ex. 2

SP – sit on the ball. Balancing. Alternating movements of the arms (AA) like during marching.
***SP – as above. Balancing. AA – flexion, bringing the elbows close together in front of the trunk, then – a swing of AA backwards.**
***SP – as above. Balancing. Horizontal scissors performed with AA raised up.**
***SP – as above. Balancing. Clap over the head and behind the back.**

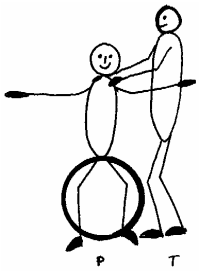


Ex.3

SP – sit on the ball. Balancing. Alternating elevation of the feet over the ground

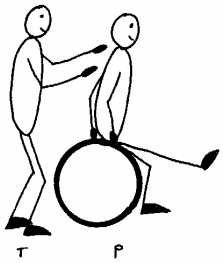
Ex.4

SP – sit on the ball. Balancing. Raising AA to the front. Fist closing and opening.



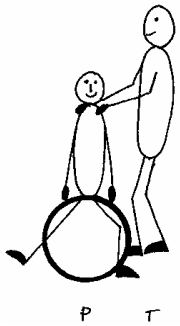
Ex.5

SP – sit on the ball. Balancing. Raising AA to the sides. Fast circular movements of AA in the shoulder joints.



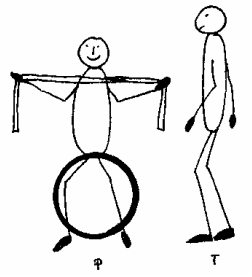
Ex.6

SP – sit on the ball. Alternating raising of LL.
***as above with dorsal flexion of the foot**
*** as above – the feet on a physiotherapy pillow**
***as above – raising L and performance of free movements imitating writing or painting with the foot.**



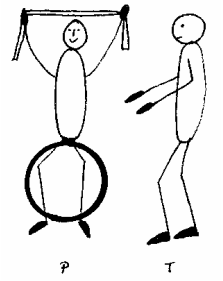
Ex.7

SP – sit on the ball. Alternating raising of LL to the sides.



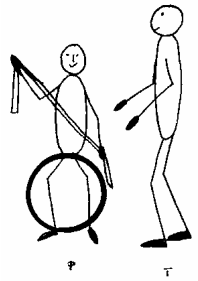
Ex.8

SP – sit on the ball. Hold the band bimanually in the horizontal position. Stretching the band at the level of the chest.



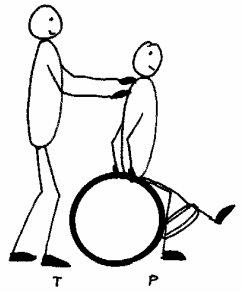
Ex.9

SP – sit on the ball. Hold the band bimanually in the horizontal position. Raising AA up and strtching the band over the head



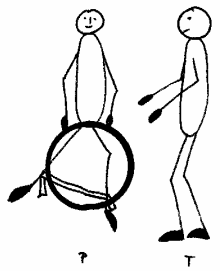
Ex.10

SP – sit on the ball. Hold the band bimanually, palms resting on the knees. Stretching the band combined with alternating raising AA up, obliquely and with turning the head and trunk.



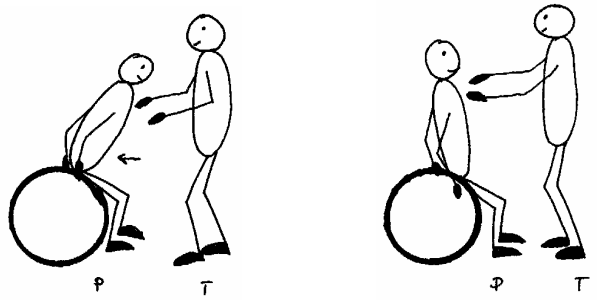
Ex.11

SP – sit on the ball. The band tied into a loop, positioned at the level of the ankle joints. Alternating raising of LL to the front.



Ex.12

SP – sit on the ball. The band tied into a loop, positioned at the level of the ankle joints. Alternating raising of LL to the sides.



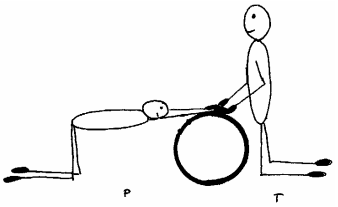
Ex.13

SP – sit on the ball. Hip movements forwards and backwards.

Ex.14

SP – sit on the ball. Alternating hip movements to the sides.

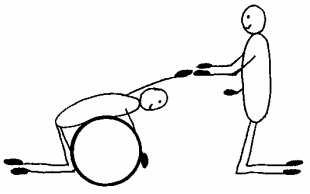
***SP – sit on the ball. Hip rotating on the ball.**

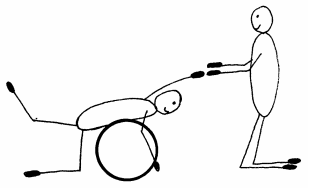


Ex.15

SP – simple kneel, palms placed on the ball. Bending the trunk forward while rolling the ball.

***SP – supported kneel, palms placed on the ball. Bending the trunk forward and rolling the ball to the sides.**

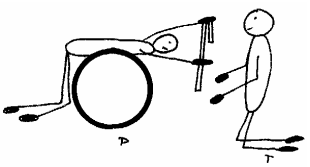




Ex.16

SP – supine position with the front on the ball. Alternating rasining AA up.

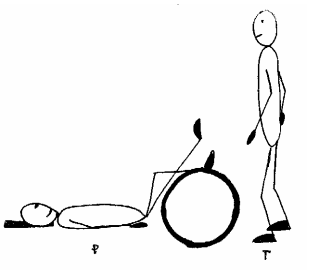
*** SP – supine position with the front on the ball. Raising the right arm (RA) and the left leg (LtL), subsequently – the left arm (LA) and the right leg (RL)**



Ex.17

SP – supine position with the front on the ball, AA up. Stretching the band in the horizontal plane.

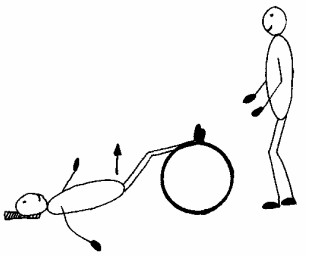
***SP - supine position with the front on the ball, AA up. Stretching the band with trunk rotation.**



Ex.18

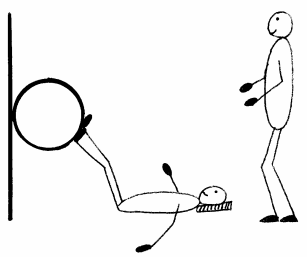
SP – supine position on the back, LL flexed over the ball. Alternating raising LL combined with dorsal flexion of the feet.

***SP – supine position on the back, LL flexed over the ball. Rolling the ball forwards with LL extension.**



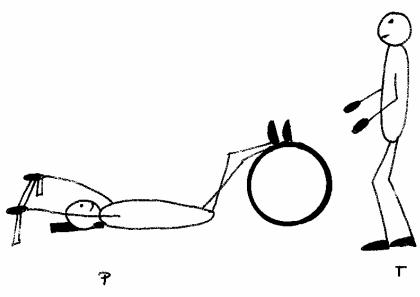
Ex.19

SP – supine position on the back, LL on the ball. Pulling in the stomach and raising the hips up



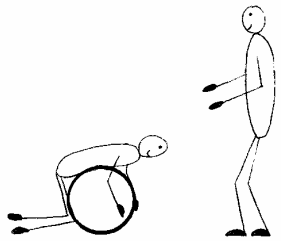
Ex.20

SP – supine position on the back, LL flexed over the ball. Rolling the ball up and down on the wall.



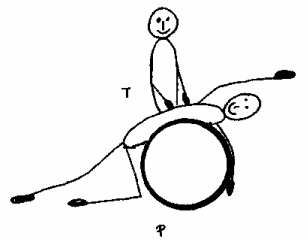
Ex.21

SP – supine position on the back, LL on the ball. raising AA up and stretching the band.



Ex.22

SP – supine position with the front on the ball, the head along the body axis. Slight rocking on the ball in various directions.



Ex.23

SP – supine position with the side on the ball while kneeling on one leg. Raising A to the side and up with inspiration, and down with expiration.